Physico - Chemical Properties of Nanostructured C-TiO_2 for Lithium Ion Batteries

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Nanostructured TiO_2 has very good properties in electrodes for lithium-ion batteries because of its high capacity, high safety and fast ionic transport. Moreover, by increasing the specific surface area in nanostructure compounds has a major influence on ionic transport and volumetric capacity [1, 2].

In this study, mesoporous TiO_2, produced by a sol-gel technique [3], is the precursor material for developing new carbonised-TiO_2 nanocomposites electrode materials. We present a microstructural investigation of mesoporous TiO_2 carbonized at 400°C (one hour in nitrogen atmosphere) and heated at 700°C (three hours in nitrogen atmosphere). To understand the behavior of the microstructure and its evolution during carbonization, we observed the effect of thermal treatment (TT) of the material in the same conditions without carbonization. Electron microscopy observations (SEM and TEM) show that the thermal treatment and carbonization process produced a complete modification of the nanostructure of the mesoporous TiO_2 (see Figure 1 (a-c)). The material loses its original mesoporosity and two crystalline phases are formed, rutile and anatase. Sample treated in nitrogen (TT-TiO_2) presents a microstructure quite similar to the carbonized sample (C-TiO_2) with polyhedral rutile crystallite of dimensions >100 nm and anatase nanoparticles of 10-50 nm in size. Amorphous carbon is dispersed on the rutile crystallite surface, mainly at the anatase grain boundaries. The main difference between the two materials is the higher percentage of carbon in the C-TiO_2 that limits the growth of anatase grains. This fact induces a higher specific surface area in the carbonized material.

The electrochemical behaviour (see Figure 2) will be discussed with respect to the microstructural results.

References
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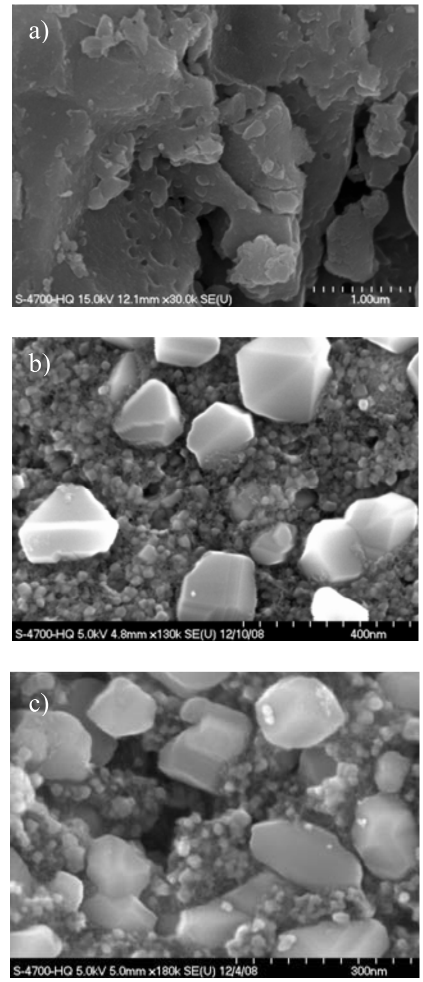

Figure 1. SEM images: (a) mesoporous TiO_2; (b) TT-TiO_2; (c) C-TiO_2.

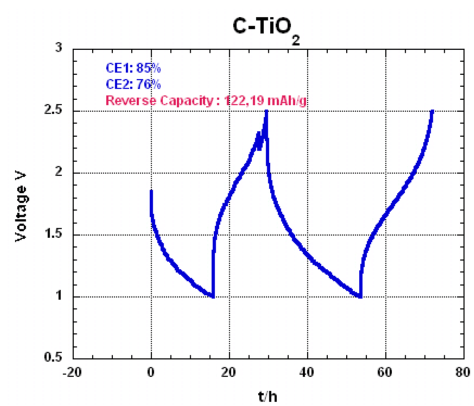

Figure 2. Discharge/charge cycle of C-TiO_2 electrode.